



PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.: 10/730,398
Filing Date: 12/8/2003
Applicant: Bieler et al.
Group Art Unit: 1742
Examiner: Sikyin Ip
Title: METHODS FOR PRODUCING LEAD-FREE IN-SITU
COMPOSITE SOLDER ALLOYS
Attorney Docket: 6550-000013/COA

DECLARATION UNDER 37 C.F.R. §1.132

1. I am an associate professor in the Department of Chemical Engineering and Materials Science at Michigan State University. I have a Ph.D. from the University of California in Materials Science, a M.S. in Ceramic Engineering from the University of Washington, and a B.A. in Applied Mechanics from the University of California.

2. I am a co-inventor of U.S. Patent Application Serial No.10/730,398 as identified above and of the subject matter described and claimed therein, including Claims 20-62. The claimed methods begin with a eutectic or near-eutectic solder composition, and add intermetallic components, to form a mixture which is compositionally altered and far-removed from a eutectic or near-eutectic solder.

3. This declaration is being presented to traverse the rejections asserted in the Office Action mailed on August 18, 2006 and to establish factual evidence in support of patentability of the presently claimed invention.

4. I have reviewed and am familiar with the references cited in the August 18, 2006 Office Action, including:

A) U.S. Patent No. 5,527,628 to Anderson et al.

5. I have reviewed and am familiar with the following additional references:

B) Miller, et al., "A Viable Tin-Lead Solder Substitute: Sn-Ag-Cu," Journal of Electronic Materials, vol. 23, no. 7, pp. 595-601 (1994).

C) Moon, et al., "Experimental and Thermodynamic Assessment of Sn-Ag-Cu Solder Alloys," Journal of Electronic Materials, vol. 29, no.10, pp. 1122-1136 (2000).

4. U.S. Patent No. 5,527,628 to Anderson et al. ('628 patent) describes a lead-free solder having a eutectic point of about 217°C for a composition of 93.6 Sn - 4.7 Ag - 1.7 Cu (wt.%). The Miller Article (B), authored by some of the inventors of the '628 patent, describes a lead-free solder that has the same composition as set forth in '628. See for example, Abstract, p. 598 Col. 1 to p. 599 Col. 1.

5. The '628 patent sets forth erroneous compositional ranges, including an erroneous eutectic composition for the Sn-Ag-Cu system. This error has been recognized by those of skill in the art, including various third parties. The Moon article (C) acknowledges this error and further states on Pages 1122 to 1123 that "[p]reliminary thermodynamic calculations performed by one of the authors [] and reported by Miller et al. [B] predicted a ternary eutectic...an error was made in the conversion from atomic to weight % conversion by Miller et al."

6. The Moon article (C) reports that the ternary eutectic composition for the Sn-Ag-Cu system is 3.5 wt. % Ag - 0.9 wt. % Cu - 95.6 wt. % Sn, with a eutectic temperature of approximately 217°C, which is now widely accepted in the art.

7. As such, those of skill in the art recognize that the compositional ranges for the eutectic Sn, Ag, and Cu system set forth in the '628 patent are incorrect and the '628 patent does not teach a eutectic lead-free solder composition.

8. A low melting point lead-free solder alloy has a composition corresponding to eutectic or near-eutectic solder where virtually the entire solder alloy melts easily into a liquid phase at soldering re-flow temperatures. Those of skill in the art recognize that adding components to a eutectic composition

alters the alloy such that it is no longer eutectic or near-eutectic and thus will no longer melt to form a solely liquid phase.

9. The '628 patent is not compositionally similar to the claimed invention. The claimed method provides a eutectic solder (as a matrix) and then further adds components of an intermetallic compound. After heating the mixture to melt the eutectic solder and the intermetallic compounds, the non-solid mixture is cooled to homogeneously distribute unmelted intermetallic components having a particle size of $<10\text{ }\mu\text{m}$ through the eutectic or near-eutectic solder matrix. The '628 patent is focused on the true eutectic (all liquid) and thus does not describe or suggest such a method to those of skill in the art.

10. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Dated: ____19 November 2006____

A handwritten signature in black ink that reads "Thomas R Bieler". The signature is written in a cursive, flowing style.

Thomas R. Bieler